What Is Claimed Is:

1. A method of controlling auto-ignition timing in an internal combustion engine cylinder having a piston that is coupled to at least one prechamber having a prechamber piston, the method comprising:

compressing gases within the at least one prechamber using the prechamber piston at precisely controlled times to cause auto-ignition in the at least one prechamber, the auto-ignition in the at least one prechamber producing hot gas jets; and

inducing auto-ignition in the cylinder by introducing the hot gas jets from the at least one prechamber into the cylinder.

2. The method of claim 1, wherein each prechamber is coupled to the cylinder by at least one microvalve and each prechamber encloses a volume that is substantially smaller than a volume enclosed by the cylinder.

3. The method of claim 1, further comprising:

enriching a fuel-air mixture in the at least one prechamber to a rich level prior to compression.

4. The method of claim 3, wherein the fuel-air mixture in the at least one prechamber is enriched to an equivalence ratio in the range of 1.1 to 2.5.

5. The method of claim 3, further comprising:

controlling the prechamber piston to compress the gases in the prechamber when the cylinder piston is near a top dead center position with the at least one microvalve of the prechamber in a closed position;

wherein auto-ignition occurs in the prechamber upon compression after a short time delay;

wherein the prechamber piston, upon completing a compression stroke remains in position during auto-ignition in the prechamber and during an interval when hot gases emanate from the prechamber into the cylinder.

6. The method of claim 5, further comprising:

opening the at least one microvalve immediately after auto-ignition in the prechamber occurs.

7. The method of claim 5, wherein the short time delay is approximately 1 millisecond (1 ms) in duration.

8. A system for homogeneous combustion jet ignition in an internal combustion engine cylinder comprising:

at least one prechamber coupled to the cylinder via at least one microvalve including a prechamber piston; and

an electronic control unit, the electronic unit receiving data regarding requested load demand and current operating parameters within the cylinder, the electronic control unit configured to control the prechamber piston and the at least one microvalve based on the received data so as to induce an auto-ignition within the at least one prechamber.

9. The system of claim 8, wherein the at least one prechamber is situated near the top of the cylinder and encloses a volume that is substantially smaller than a volume enclosed by the cylinder.

10. The system of claim 8, further comprising:

intake means for delivering fuel to the at least one prechamber.

11. The system of claim 9, wherein the electronic control unit precisely controls the piston of at least one prechamber to:

(a) perform an intake stroke during an intake stroke of the cylinder piston;

(b) begin a compression stroke during a compression stroke of the cylinder piston,

(c) complete the compression stroke near a top-dead-center (TDC) position of the cylinder piston.

(d) remain in place at the end of the compression stroke during auto-ignition in the prechamber and during a subsequent exhaust of hot gases from the at least one prechamber into the cylinder.

12. The system of claim 11 wherein the electronic control unit precisely controls the at least one microvalve of the least one prechamber to:

(a) remain open during the intake stroke of the prechamber piston;

(b) close during the compression stroke of the prechamber piston; and

(c) open following auto-ignition of the contents of the at least one prechamber.

13. The system of claim 8, wherein the at least one microvalve includes an actuator coupled to a needle, the actuator causing the needle to shift, the shift of the needle opening or closing an orifice in the prechamber that leads to the cylinder

14. The system of claim 13, wherein the actuator comprises a magnetic solenoid and coil.

15. The system of claim 13, wherein the actuator comprises a piezoelectric stack.

16. The system of claim 13, wherein the actuator comprises a piezoelectric membrane.